

## CLAIMS

We claim:

1. A multilayer device, comprising:
  - (a) at least a first layer comprised of a material suitable for attachment and culturing of animal cells and having a pattern of microchannels therein,
    - (i) wherein the channels are suitable for the attachment and culturing of animal cells within the channels, and
    - (ii) wherein the channels are connected for the circulation of fluid through the layer; and
  - (b) at least a second layer comprised of a material suitable for attachment and culturing of animal cells,wherein the first and second layers are joined or fastened together.
2. The multilayer device of claim 1, wherein channels are formed by joining or fastening the first and second layers.
3. The multilayer device of claim 1, wherein the channels of the first layer have a minimum dimension of from about 5 microns to about 500 microns.
3. The multilayer device of claim 1, wherein the material of the first layer is selected from the group consisting of silicon, glass, ceramics and polymeric materials.
4. The multilayer device of claim 1, wherein the materials of all the layers of the multilayer device are selected from the group consisting of silicon, glass, ceramics and polymeric materials.
5. The multilayer device of claim 1, wherein the material of the first layer is biodegradable.

6. The multilayer device of claim 1, wherein the materials of all the layers of the multilayer device are biodegradable.
7. The multilayer device of claim 1, wherein the second layer has a pattern of microchannels therein.
8. The multilayer device of claim 7, wherein the pattern in the first and second layers are similar.
9. The multilayer device of claim 7, wherein the pattern in the first and second layers are different.
10. The multilayer device of claim 7, wherein the pattern in the first layer is suitable for the culturing of endothelial cells and the layer in the second layer is suitable for the culturing of parenchymal cells.
11. The multilayer device of claim 7, wherein the patterns of the first and second layers are aligned to form a vasculature.
12. The multilayer device of claim 1, wherein the channels of the first layer are connected beginning from one or more inlets, expanding into more channels, and then converging back into one or more outlets.
13. The multilayer device of claim 1, wherein the channels of all the layers of the multilayer device are connected beginning from one or more inlets, expanding into more channels, and then converging back into one or more outlets.

14. The multilayer device of claim 1, further comprising a third layer for comprised of a material suitable for attachment and culturing of animal cells, wherein the first, second and third layers are joined or fastened together.
15. The multilayer device of claim 14,
  - (a) wherein the second layer is unpatterned; and
  - (b) wherein the third layer has a pattern of channels therein,
    - (i) wherein the channels are suitable for the attachment and culturing of animal cells within the channels, and
    - (ii) wherein the channels are connected for the circulation of fluid through the layer.
16. The multilayer device of claim 15, wherein the pattern in the first and third layers are similar.
17. The multilayer device of claim 15, wherein the pattern in the first and third layers are different.
18. The multilayer device of claim 17, wherein the pattern in the first layer is suitable for the culturing of endothelial cells and the layer in the third layer is suitable for the culturing of parenchymal cells.
19. The multilayer device of claim 1, wherein the animal cells are selected from the group consisting of endothelial cells, parenchymal cells, bone marrow cells, osteoblasts, mesenchymal stem cells, satellite cells, and fibroblasts.
20. The multilayer device of claim 1, wherein the cells cultured in the channels of the first layer are endothelial cells.

21. The multilayer device of claim 1, wherein one or more of the layers comprise through-holes.
22. The multilayer device of claim 1, wherein one or more of the layers comprise an alignment indentation on the surface of a layer and an alignment protrusion on an opposing surface of a layer, the alignment indentations shaped to mate with the alignment protrusion.
23. The multilayer device of claim 1, wherein the first layer is subdivided into zones of animal cell support.
24. The multilayer device of claim 23, wherein the zones of animal cell support comprise cell adhesion molecules.
25. A method of making a multilayer device, comprising the steps of:
- (a) obtaining at least a first layer comprised of a material suitable for attachment and culturing of animal cells and having a pattern of channels therein,
    - (i) wherein the channels are suitable for the attachment and culturing of animal cells within the channels, and
    - (ii) wherein the channels are connected for the circulation of fluid through the layer; and
  - (b) obtaining at least a second layer for supporting animal cell growth wherein the second layer is comprised of a material suitable for attachment and culturing of animal cells; and
  - (c) joining or fastening together the first and second layers.

26. The method of claim 25, wherein the joining or fastening is by a method selected from the group consisting of the methods of solvent bonding; reflow by heating; treating the surface of the layer with oxygen plasma; polymer flow at the surface of the layer, mechanically fastening the layers with fasteners selected from the group comprising barbs, pins, screws, clamps, staples, wires, string, and sutures; and adhering the layers by the use of adhesives, adhesive films or adhesive layers.
27. A method of making a multilayer device, comprising the steps of:
- (a) obtaining a layer comprised of a material suitable for attachment and culturing of animal cells and having a pattern of channels therein,
    - (i) wherein the channels are suitable for the attachment and culturing of animal cells within the channels, and
    - (ii) wherein the channels are connected for the circulation of fluid through the layer; and
  - (b) folding or rolling the layer to form a multilayer device having channels.
28. A method of making a multilayer device containing animal cells, comprising the steps of:
- (a) obtaining a multilayer device, comprising:
    - (i) at least a first layer comprised of a material suitable for attachment and culturing of animal cells and having a pattern of microchannels therein,
      - (A) wherein the pattern of channels are suitable for the attachment and culturing of animal cells within the channels, and
      - (B) wherein the pattern of channels are connected for the circulation of fluid through the layer; and
    - (ii) at least a second layer, wherein the second layer is comprised of a material suitable for attachment and culturing of animal cells,wherein the first and second layers are fastened together, and
  - (b) adding, loading or seeding animal cells onto at least the first layer.

29. The method of claim 28, wherein the animal cells are selected from the group consisting of endothelial cells, parenchymal cells, bone marrow cells, osteoblasts, mesenchymal stem cells, satellite cells, and fibroblasts.
30. The method of claim 28, further comprising the step of:
  - (c) seeding animal cells to into the channels.
31. The method of claim 28, wherein the animal cells are endothelial cells.
32. A method of implanting a bioartificial organ into a recipient, comprising:
  - (a) obtaining a multilayer device, comprising:
    - (i) at least a first layer comprised of a material suitable for attachment and culturing of animal cells and having a pattern of microchannels therein,
      - (A) wherein the channels are suitable for the attachment and culturing of animal cells within the channels, and
      - (B) wherein the channels are connected for the circulation of fluid through the layer; and
    - (ii) at least a second layer wherein the second layer is comprised of a material suitable for attachment and culturing of animal cells,the layers of the multilayer device being fastened together;  
the multilayer device comprising animal cells; and
  - (b) implanting the multilayer device comprising animal cells into the recipient, wherein the implanted multilayer device comprising animal cells is a bioartificial organ.

33. An image reversal method for forming a scaffold having a material having a pattern of microchannels therein, comprising
- (a) selecting a mold having a complex pattern of microchannels on the mold in a reverse image of the channels; and
  - (b) replica molding the pattern from the mold to a material suitable for attachment and culturing of animal cells;
- wherein the replica molding forms a scaffold having a complex pattern of microchannels therein.
34. A multilayer device, comprising:
- (a) multiple layers of tissue;
  - (b) multiple layers of material suitable for attachment and growth of tissue and having a pattern of microchannels in the material;
  - (b) vasculature within the tissue or on the material; and
  - (c) connections for flow into and out of the vasculature.
35. The multilayer device of claim 34, wherein the vasculature comprises endothelial cells.
36. The multilayer device of claim 35, further comprising cells selected from the group consisting of parenchymal cells, cells forming cartilage or bone, muscle cells, and nerve cells.

37. The multilayer device of claim 36, wherein the parenchymal cells are derived from organs selected from the group consisting of heart, liver, pancreas, intestine, kidney, reproductive tissues and lung.

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